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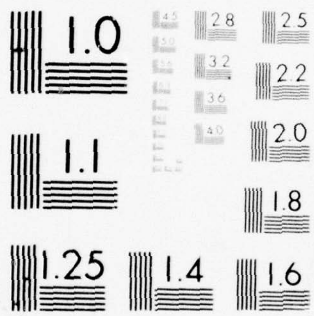

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PSYCHOBIOLOGICAL PREDICTORS OF SUCCESS IN A NAVY REMEDIAL READING PROGRAM

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Early discharge of enlisted men for unsuitability is a serious and growing problem for the military services. The presently available methods of identifying the failure prone recruit are not adequate. The purposes of this research were: (1) To investigate newly developed computer-based methods of recording and analyzing electrophysiological measures and to determine their value in identifying recruits at high risk of premature discharge, and (2) to determine how psychobiological methods might be used in individualizing

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instruction or otherwise improving the remediability of the failure-prone recruit. Visual evoked potentials were used to derive measures of amplitude, asymmetry, variance, and latency. Data were gathered for 73 recruits who had been assigned to Academic Remedial Training (ART). Correlational and discriminant analyses of the data found that several of the evoked potential measures appeared to be of value in distinguishing those recruits who later graduated and went on to active duty (N = 32) from those who failed remedial training and were discharged (N = 41). Follow-up studies have been initated to determine if the results can be confirmed on additional recruit samples and if more sophisticated software and statistical methods can improve the predictive values of the psychobiological approach. Alternative forms of remediation will be recommended for those for whom present techniques are least appropriate.

FOREWORD

This research and development was conducted in support of Exploratory Development Task Area ZF61-512-001-03.01 (Evaluation of Psychobiological Methods in the Screening and Selection of Personnel) under the sponsorship of the Director of Navy Laboratories. This is the first in a series of reports on psychobiological measures as potential devices for personnel screening and for the enhancement of training and performance.

Appreciation is expressed to Mr. Peter Harris and Mr. Jack Klingelhofer of the University of California Medical Center, San Francisco, for their work on the computer system, and the staff members of the Recruit Evaluation Unit and the Academic Remedial Training Unit at Naval Training Center, San Diego.

J. J. CLARKIN
Commanding Officer

SUMMARY

Problem

A large and increasing percentage of the men recruited into the Navy are eventually found to be unsatisfactory. Many are discharged prematurely, and many of those who do complete their terms of enlistment fail to meet the standards for reenlistment. Satisfactory techniques are not available for identifying and screening out the failure-prone, or for remediating their deficiencies so they can become useful members of the service.

Objective

This project was undertaken to evaluate newly developed computer-based methods of recording and analyzing psychobiological (visual evoked potential) measures as a means of identifying recruits with a high risk of premature discharge, for subsequent use in the screening and/or remediation process.

Approach

Visual evoked brain potentials (VEP) were used to assess high-risk recruits ($N = 73$) who had been assigned to academic remedial training. Measures of VEP amplitude, asymmetry, and latency served as predictors. The criterion was successful completion of training (Active Duty group, $N = 32$) or failure to complete training (Discharge group, $N = 41$). The VEP measures were evaluated by correlational and discriminant analyses.

Results

A biserial correlation of .32 ($p < .05$) was obtained between frontal right hemisphere amplitude and the Active Duty-Discharge criterion. The same measure was found by discriminant analysis to contribute maximally to between-group variance ($F_{1,34} = 5.59$, $p < .02$). Adding a second variate, parietal left hemisphere amplitude, was found to improve prediction. The two-variate combination was found to cross-validate significantly on the test sample ($X^2 = 5.56$, $p < .02$).

Conclusion

The present research demonstrated that recruits discharged prematurely from training showed VEP characteristics, derived by computer-averaging techniques, which distinguished them from men of approximately equal aptitude who successfully completed the recruit training. The VEP differences observed suggested that the men who failed to learn under the present form of remedial training might benefit from a different instructional emphasis.

Recommendation

The present findings are encouraging. They support the continuance of ongoing efforts to develop psychobiological methods of addressing the problem of recruit attrition by improving the processes of screening and remediation.

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INTRODUCTION

Problem

The Chief of Naval Operations recently cited personnel quality as the Navy's number one problem. Current projections show that less than half of all personnel entering the Navy in 1976 may be considered satisfactory, where satisfactory is defined as completing the full first enlistment and being recommended for reenlistment (Watkins, Note 1). The rate of enlistment of men who turn out to be unsatisfactory has doubled in the last decade.

The high rate of premature discharge is especially costly, not only in terms of money, administrative activity, and preparedness, but also in terms of the reputations and self-esteem of the young men who are initially accepted and later stigmatized as unsuitable.

Purpose

This project was undertaken to evaluate newly developed computer-based methods of recording and analyzing psychobiological (visual evoked potential) measures as a means of identifying recruits at high risk of premature discharge, and, from among those, the recruits whose deficits are most likely to be corrected by remedial training.

Background

The military services have a long history of research on the problem of recruit screening. Although a variety of approaches has been applied in the attempts to identify those who are most likely to fail, the process has largely depended upon various kinds of paper and pencil tests, supplemented by information gathered from contact with people or agencies acquainted with the prospective recruit. Until recently, recruiters could readily obtain information on expulsion (from school authorities) and records of arrests (from law enforcement officers). However, privacy and confidentiality considerations have now sharply curtailed the availability of such information. As the need for screening information has increased, the availability of the information has decreased (Sands, Note 2).

The paper and pencil test components of traditional screening procedures, while they unquestionably contribute valuable information, are also subject to serious shortcomings. Criticisms have been leveled against such tests on the grounds that deliberate falsification is often possible, racial imbalance may result, and, most serious, their effectiveness in screening out failure-prone recruits is rather low. A large variety of paper and pencil tests has been tried experimentally over the years, but few have been found to contribute information useful in the screening process.

One approach to screening that warrants careful investigation is the use of psychobiological measures as predictors of aberrant or ineffective performance. Among other advantages, psychobiological testing represents an objective, hard to falsify procedure that is relatively immune to the charges of bias leveled against the traditional screening and selection tests. Further, research on brain function reported within the past decade suggests that in

predicting nonacademic criteria, psychobiological tests may exceed paper and pencil tests. Most paper and pencil tests measure the kinds of logical, sequential analytical functions served by the dominant (usually left) hemisphere of the brain (Dimond & Beaumont, 1974). Many of the abilities required for effective performance in nonacademic tasks (including most Navy assignments) are best characterized as involving the spatial, judgmental, integrative, and simultaneous information-processing skills that appear to be served by the right hemisphere in most people. It seems safe to assume that at least part of the failure of traditional tests to predict real-life performance resides in the heavy demand that conventional tests place on left hemisphere functions. While there is no assurance that psychobiological testing will overcome or compensate for the shortcomings of conventional tests, the prospects are sufficiently encouraging, and the problem of premature attrition so severe, that the psychobiological approach seems well worth exploring. The present report describes the application of one type of psychobiological testing--visual evoked potential (VEP) analysis--to the problem of recruit attrition.

Psychobiological testing methods have two different but related roles in reducing recruit attrition. The first involves the decision on which applicants to accept, and which to exclude from the Navy. The second role involves the decision on which type of training, including remedial training, a given recruit should have in order to maximize his chances for remaining in the Navy and contributing in a positive way to the Navy's mission.

When first developed, VEP measuring techniques were so crude that only rather gross neurological abnormalities had any chance of being detected. Recent developments in computer science and electronics have greatly altered this situation, and now highly sophisticated instruments and techniques are available. The Applied Psychobiology Program of the Navy Personnel Research and Development Center was established to investigate the possibility of employing psychobiological measures and other high-technology methods to solve such Navy personnel problems as recruit screening. The present report is the first in a series describing our efforts. If this work is successful, it is envisioned that such tests would be administered to some fraction, perhaps one-fourth or one-third, of the young men who are being considered for induction. Paper and pencil tests, or other more traditional information gathering devices, would be used to identify those at highest risk of being discharged. Such individuals would be designated for further testing. The psychobiological tests could be carried out at main recruiting stations or other centralized locations, using instrumentation similar to that employed in this research. A major function of NAVPERSRANDCEN's laboratory is improvement of the methods of testing, so that the operational implementation of laboratory findings, if implementation is called for, can be readily accomplished.

The type of psychobiological activity analyzed in this study is the evoked potential (EP). Evoked potentials are minute electrical brain waves produced by sensory stimulation, which are ordinarily buried in ongoing electroencephalographic (EEG) activity of larger amplitude. Advances in electronics and computer design have made possible the recording and measurement of EPs. The use of the computer to record and average the EP so that it may be seen against the background noise of the EEG has provided a dramatic impetus to research in this field.

APPROACH

The present study is one of a series in which various naval populations are tested and then monitored over their entire first enlistments to determine how well the EP tests predict attrition and job performance. As the first in the series, the present study used as subjects a high-risk group with a greater than average probability of early discharge from the service--students at the Academic Remedial Training (ART) unit at the Naval Training Center (NTC), San Diego. These recruits had been admitted into the Navy despite a rather poor level of reading ability. Because reading is such a vital skill not only to the Navy, but also in the civilian economy, these students were of special interest.

Subjects

The subjects (N = 73) were white males with an average age of about 19 years. Their scores on the Armed Forces Qualification Test (AFQT) fell between the 20th and 40th centiles. They had scored between the 3.0 and 5.5 grade levels on the Gates-MacGinitie Reading Test and thus could not read as well as the average 11- or 12-year-old.

Of the 73 men, 32 improved enough during ART to be continued on active duty (ACT group), while 41 failed ART and were discharged from the Navy (DIS group). The research task was to find if EP measures could predict group membership.

The mean and standard deviation for AFQT were 35.5 ± 7.8 centiles for the ACT group and 33.7 ± 10.0 centiles for the DIS group. Entering means and standard deviations of reading grade levels were 4.4 ± .7 for the ACT group and 3.9 ± .7 for the DIS group.

Instrumentation

The instrumentation used in this study was based on a state-of-the-art field-portable computer system previously described by Callaway (1975). It was placed on-site at NTC to facilitate data collection (Figure 1). The system was based on a Data General NOVA 1220 central processing unit (CPU) with 16K core, 16-bit word length, hardware multiply and divide, and direct memory access with a floppy disk unit (Advanced Electronics Design, Model 2500). The CPU, the floppy disk unit, the EEG amplifier, filter circuitry, and the alphanumeric oscilloscope monitor (Tektronix Model 603) were mounted in a single cabinet 30 inches high, 24 inches deep, and 22 inches wide (76 x 61 x 56 cm). The entire unit weighed about 180 pounds (82 kg). Peripheral to the cabinet were the small solid-state keyboard, a fluorescent tube and power supply for the visual stimulus, and the small EEG multiplex and preamplifier unit. The latter unit capacitive coupled, multiplexed, preamplified (about 200X), and optically isolated the EEG signals. At the computer, the signals were demultiplexed and further amplified for a total gain of about 20,000X. Amplifier frequency response was flat to about 150 Hz. The eight filters were passive resistor-capacitor circuits with a frequency rolloff of about 3 db per octave. Three time constants (.1, 1, and 10 seconds) were available for the high-pass filters and corresponded to approximately 2.0, .2, and .02 Hz. Two low-pass filter options (30 and 100 Hz) were available.

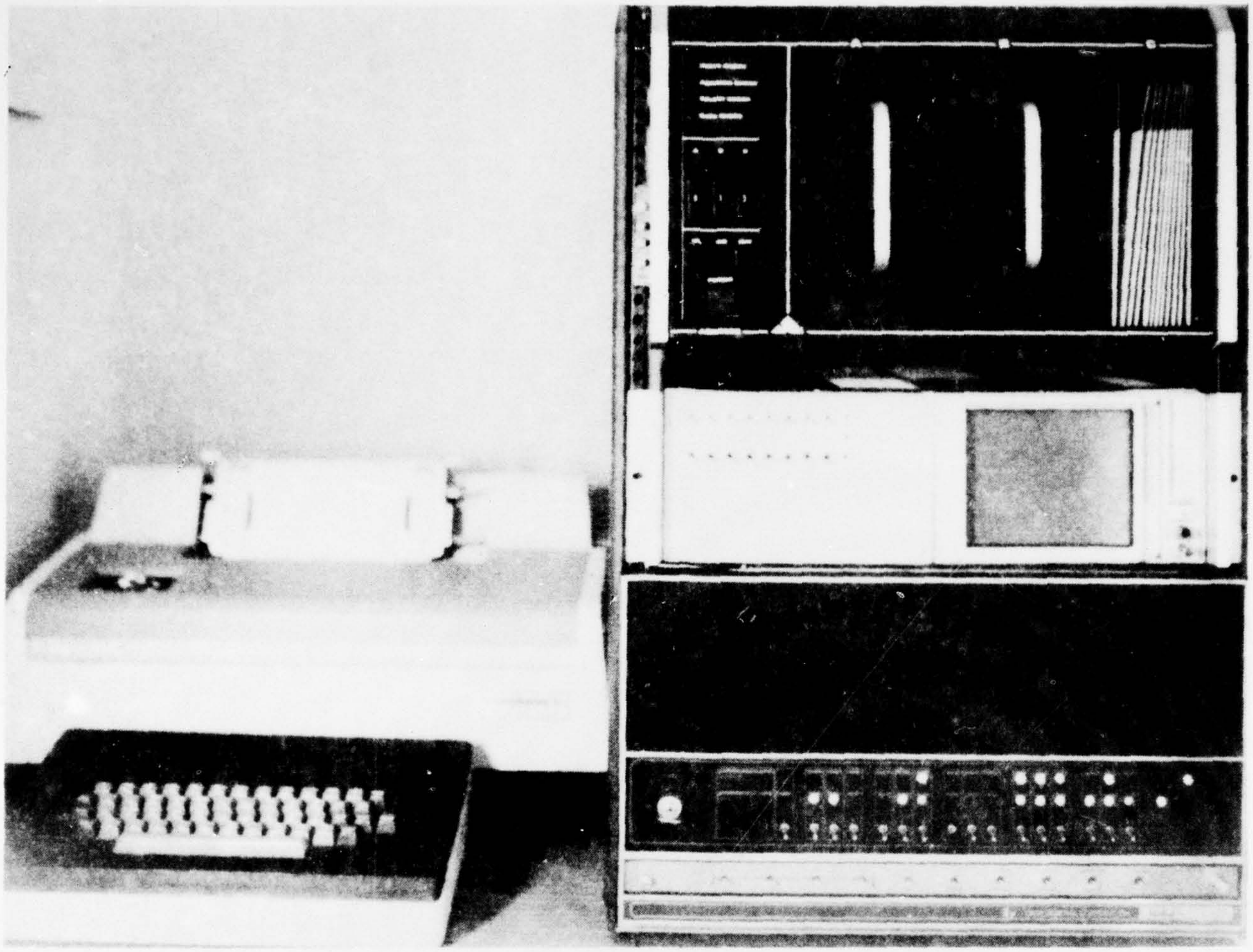

Figure 1. Computer used in EP analysis. Cabinet contains the central processing unit, EEG electronics, and floppy disk. Also shown are the keyboard and high-speed printer.

Software

A single keyboard character command provided access to any of the desired subroutines. These included impedance monitoring; calibration; a real-time, simultaneous display of the eight channels of EEG activity; subject identification entry; acquisition; and analysis of the visual EPs.

Visual Stimuli

A commercial fluorescent tube (GE Model F8T5-CWUSA) with a custom-built power supply was triggered by a computer-generated pulse. The stimulus duration was approximately 2 msec, flashed aperiodically with a mean inter-flash interval of about 1.5 seconds. The target was a homogeneous white rectangle (approximately 7" x 15", or 18 x 38 cm) placed at a 1-meter viewing distance from the recruit. Luminance of the target was approximately 3 foot-Lamberts (Gamma Scientific telephotometer system, model 2009K). The visual stimulus was presented to the subject in two series of 50 flashes each during the first phase of testing, and in a single series of 100 flashes during the second phase.

Definition of EP Measures Obtained

Amplitude

The amplitude was a measure of the average power at each of the electrode sites and was measured in microvolts root mean square (μVrms). At each electrode site, EPs were averaged separately for the first and second 50 flashes. The X-axis (time = 500 msec) for each EP used 250 address (time point) locations in the computer. During the averaging, voltages at a particular address for each EP were obtained. The mean voltage was determined for the entire EP. The deviations from this mean value at each time point were squared, the average of the squared deviation was obtained, and the square root of the average was determined. The value obtained represented the standard deviation of the EP and thus provided, in effect, an approximation of the square root of the average power in microvolts root mean square (μVrms). The μVrms measure has been found to be correlated with the EP component measures more commonly used (Seales, Naitoh, & Lewis, Note 3). The standard deviation was used instead of the variance to keep the units in microvolts instead of watts (Callaway, 1975, p. 150). An average power value was determined for each of the two sets of 50-flash EPs.

Asymmetry

EP asymmetry is an index of the difference in the evoked voltages (μVrms) measured from homologous sites on the scalp. The more dissimilar the hemispheres in the amplitude of response, the higher the asymmetry values. Four asymmetry values were obtained simultaneously, since EPs were measured at each of the four pairs of left and right hemisphere sites (frontal, central, parietal, occipital). Asymmetry was analyzed both as a difference (L - R) and as a ratio (L/R).

Variance

EP variance measures the overall trial to trial variability of EPs. At each light flash all 8 EPs are summed to provide a single EP. Then, for each of the 250 time points a sum and sum of squares are computed so that at the end of 100 flashes, 250 standard deviations can be computed. These are averaged to provide the final measure.

Latency

Latency is defined as the time delay (msec) from the onset of the stimulus to a designated feature of the EP waveform. In this study, EP latency was determined from the onset of the visual stimulus to the first, second, and third positive slope zero-crosses (i.e., approximately 100, 200, and 300 msec, respectively), to be referred to as L1, L2, L3. Zero-cross was defined as the point where the waveform passed through base line (zero voltage) in the positive direction.

Procedures

The subjects were prepared for recording after they had received brief instruction and had signed voluntary consent forms.

After the technician had cleansed the hair and scalp at the electrode sites with an alcohol-impregnated cotton swab, a Lycra helmet was placed on the subject's head. Lucite bushings, secured to the helmet, held the electrodes in place at the desired recording sites (Jasper, 1958). The electrodes were of the standard EEG recording type (Beckman miniature, 11 mm), each having a clear plastic extension tube attached and filled with electrolytic solution. A small sponge soaked with electrolyte held the solution in the tube and made contact with electrode paste on the scalp. The extension tube minimized slow potential drift, which otherwise would have been picked up at the recording site.

Eight channels of visual evoked potential (VEP) data were acquired from homologous sites on the left and right hemispheres: frontal (F3, F4), central (C3, C4), parietal (P3, P4), and occipital (O1, O2). Each channel was referenced to the vertex (Cz). Subject ground was on the sagittal (mid) line in the parietal region (P_z).

After all electrodes were in place and the impedance was checked (< 5KΩ), the subject was instructed to observe his real-time EEG activity on the oscilloscope display. He was then instructed to move his jaws, eyebrows, etc., so that he could observe how muscle artifact may contaminate the VEP data. The subject was then seated in a darkened room in alignment with the visual stimulus. A hand-held "time-out" switch was given to the subject which permitted him to suspend all stimulus presentation and analysis operations. He was instructed to press the switch to reject muscle artifact when he had to move, cough, etc. The experimental session was divided into phases A and B.

Phase A - Amplitude, Asymmetry, and Variance

In phase A the subject observed computer-generated aperiodic flashes in two series of 50 flashes each, while amplitude data were obtained from each of the eight channels referenced to Cz. Band pass was between approximately 2.0 and 30 Hz for this phase. Waveforms and amplitude (μVrms) values were recorded separately for the first and second 50 flashes and displayed on the monitor scope. The first 50 flashes were designated by number 1 and the second 50 by number 2 (e.g., frontal 1, frontal 2). A Polaroid photo was made of the data display. Figures 2a and 2b present a sample of the data derived from a subject in phase A.

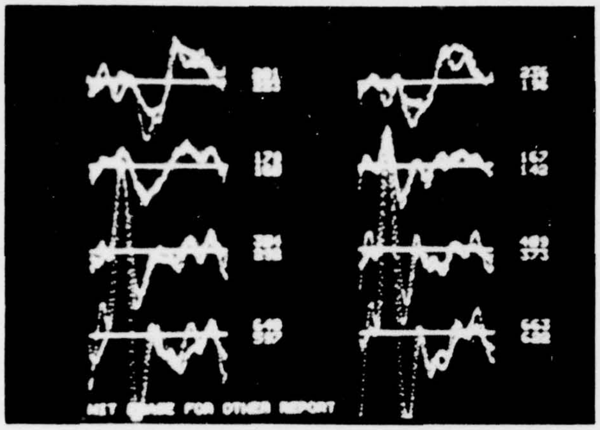

Figure 2a

Amplitude data showing left and right hemisphere EPs in the left and right columns, respectively. The locations are frontal, central, parietal, and occipital, reading from top to bottom. The upper number at each site represents the μVrms value for the first 50 flashes and the lower number the second 50 flashes. The waveforms for each 50 flash series are superimposed on the same baseline.

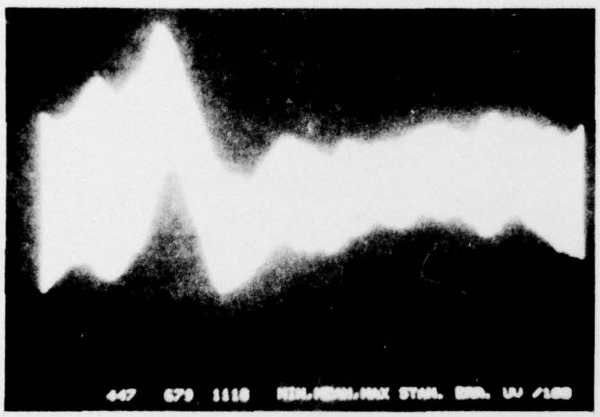

Figure 2b

Variance waveforms, displaying composite amplitude variability of all eight recording sites for 100 flashes. Numerical values at bottom represent minimum, mean, and maximum standard error measures, respectively.

Figure 2. Sample EP data recorded by Polaroid photos from display monitor.

Phase B - Latency Measures

In phase B, procedures similar to those used by Ertl and Schafer (1969) were used to obtain latency values. Rather than the computer-generated aperiodic flashes used in phase A, the flash was triggered in phase B by the subject's own EEG activity (self-stimulation). Band pass was between approximately .2 and 30 Hz for this phase. The subject's EEG activity between frontal and parietal right hemisphere sites was monitored by computer. When the EEG activity passed through the base line (zero-cross), with a positive slope, the light flashed and the resultant EP was recorded. The reliability of the EP latency measures was increased by taking into account the background EEG activity. Latency values for the three zero-crosses were computed (L1, L2, L3) and displayed on the scope monitor along with the analog EP waveform. A Polaroid photo was made of the data (Figure 2c) after the latency values had been averaged for 100 flashes.

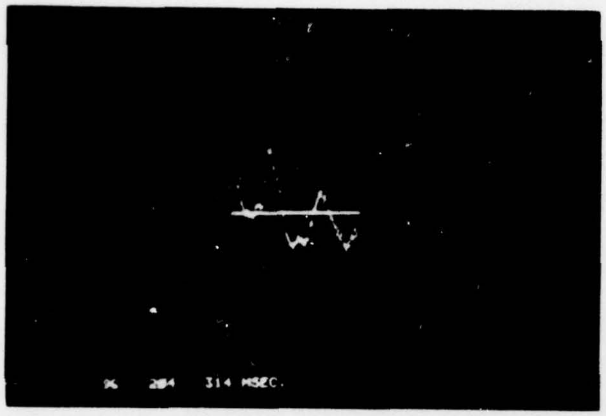

Figure 2c

Latency EP waveform recorded between right hemisphere frontal and parietal sites, for 100 flashes. The first, second, and third zero-cross latency values (msec) are displayed under the waveform.

Figure 2. Sample EP data recorded by Polaroid photos from display monitor.

RESULTS

Biserial Correlations

Biserial correlations were computed between selected VEP variates and the Active Duty-Discharge criterion. Table 1 presents these correlations for the phase A data.

Table 1

Biserial Correlations Between EP Amplitude and Asymmetry and the Active Duty-Discharge Criterion

Recording Site and Series	Amplitude L. Hemis.	Amplitude R. Hemis.	Asymmetry L - R	Asymmetry L/R
Frontal 1	.11	.32*	-.10	-.30*
Frontal 2	.09	.03	.08	.00
Central 1	.05	.10	-.04	-.12
Central 2	-.04	.16	-.17	.00
Parietal 1	.06	.15	-.13	.07
Parietal 2	.06	.23	-.21	.04
Occipital 1	.12	.15	-.07	.08
Occipital 2	.03	.15	-.22	.08

*$p < .05$

As may be seen in Table 1, the only significant correlations found were those involving the signals from the frontal region during the first 50 flashes. Both the right frontal amplitude and the frontal asymmetry ratio correlated significantly with the criterion ($p < .05$). No biserial correlation exceeded .09 (not significant) for either the variance or the three latency measures and the criterion.

Discriminant Analysis

To determine the multivariate validity of the VEP measures, a stepwise discriminant (DA) analysis (Dixon, 1973) was employed.

The ACT and DIS groups were split into training and test subgroups for the analysis. For the ACT samples; training N = 16, test N = 16. For the DIS groups; training N = 20, test N = 21. The results of the DA on the training set were applied to the test set for cross validation.

Because the smallest number of subjects in any of the four groups was 16, the number of variates was limited to 8. This was intended to decrease bias in DA error rate estimation (Larsen, Walter, McNew, & Adey, 1971).

The eight variates used were frontal 1 and 2 and parietal 1 and 2 amplitudes from both hemispheres. The frontal sites were used because the right frontal had been found to correlate with the ACT-DIS criterion (Table 1). The parietal amplitudes were included because of the findings of Conners (1971) and Preston, Guthrie, and Childs (1974). Both studies reported a reduced EP amplitude in the left parietal region, as compared to the right, in their comparisons of EPs from groups of poor readers and normal-reading controls. Table 2 presents a summary of the DA results.

Frontal 1 right hemisphere amplitude was the first variate selected by the DA as providing the greatest contribution to between-groups variance ($F\ (1,34) = 5.59;\ p < .025$). Frontal 1 was found to classify 62 percent of the test groups correctly ($X^2 = 2.80$, N.S.).

At step 2, parietal 2 left hemisphere amplitude was found to contribute maximally to prediction of the criterion. The percentage of recruits in the test set correctly classified was increased to 68 ($X^2 = 5.56,\ p < .025$).

The distribution statistics for the selected variates are presented in Table 3.

Figure 3 depicts the cases on a bivariate scatterplot whose axes are the frontal and parietal variates identified by the discriminant analysis. The two training and two test groups are identified as such; the univariate and bivariate lines predictive of membership in the ACT and DIS groups are labeled A and B, respectively.

Table 2

Discriminant Analysis Summary
Active Duty vs. Discharged Recruit Group Comparisons

			Correct Classification[a]						Chi-Square	
			Training			Test			Training	Test
Step Number	Variate	F	ACT (N = 16)	DIS (N = 20)	Total (N = 36)	ACT (N = 16)	DIS (N = 21)	Total (N = 37)	(N = 36)	(N = 37)
1	Frontal 1 RH	5.59**	50 (8)	65 (13)	58 (21)	50 (8)	71 (15)	62 (23)	1.56	2.80
2	Parietal 2 LH	3.22	63 (10)	70 (14)	67 (24)	56 (9)	76 (16)	68 (25)	5.23*	5.56**

[a]Top entry in each cell is percentage correctly classified; lower entry, in parens, is frequency.

**$p < .025$
*$p < .05$

Table 3

Means and Standard Deviations for
EP Variates Selected by Discriminant Analysis

Variate	ACT (N = 32)		DIS (N = 41)		Significance Tests	
	$\bar{X}$	SD	$\bar{X}$	SD	$t_{(71\ df)}$	$F_{(31,\ 40\ df)}$
Left Hemisphere						
Frontal 1	2.65	1.95	2.39	1.05	.74	3.40*
Frontal 2	2.49	1.77	2.29	1.03	.60	2.96*
Parietal 1	2.24	1.13	2.14	.88	.42	1.63
Parietal 2	2.05	1.00	1.97	.78	.39	1.65
Right Hemisphere						
Frontal 1	2.39	.98	1.92	.83	2.20*	1.40
Frontal 2	2.17	.89	2.13	1.11	- .16	1.53
Parietal 1	2.54	1.47	2.25	.91	.98	2.63*
Parietal 2	2.19	1.25	1.91	.50	1.19	6.36*

*$p < .05$

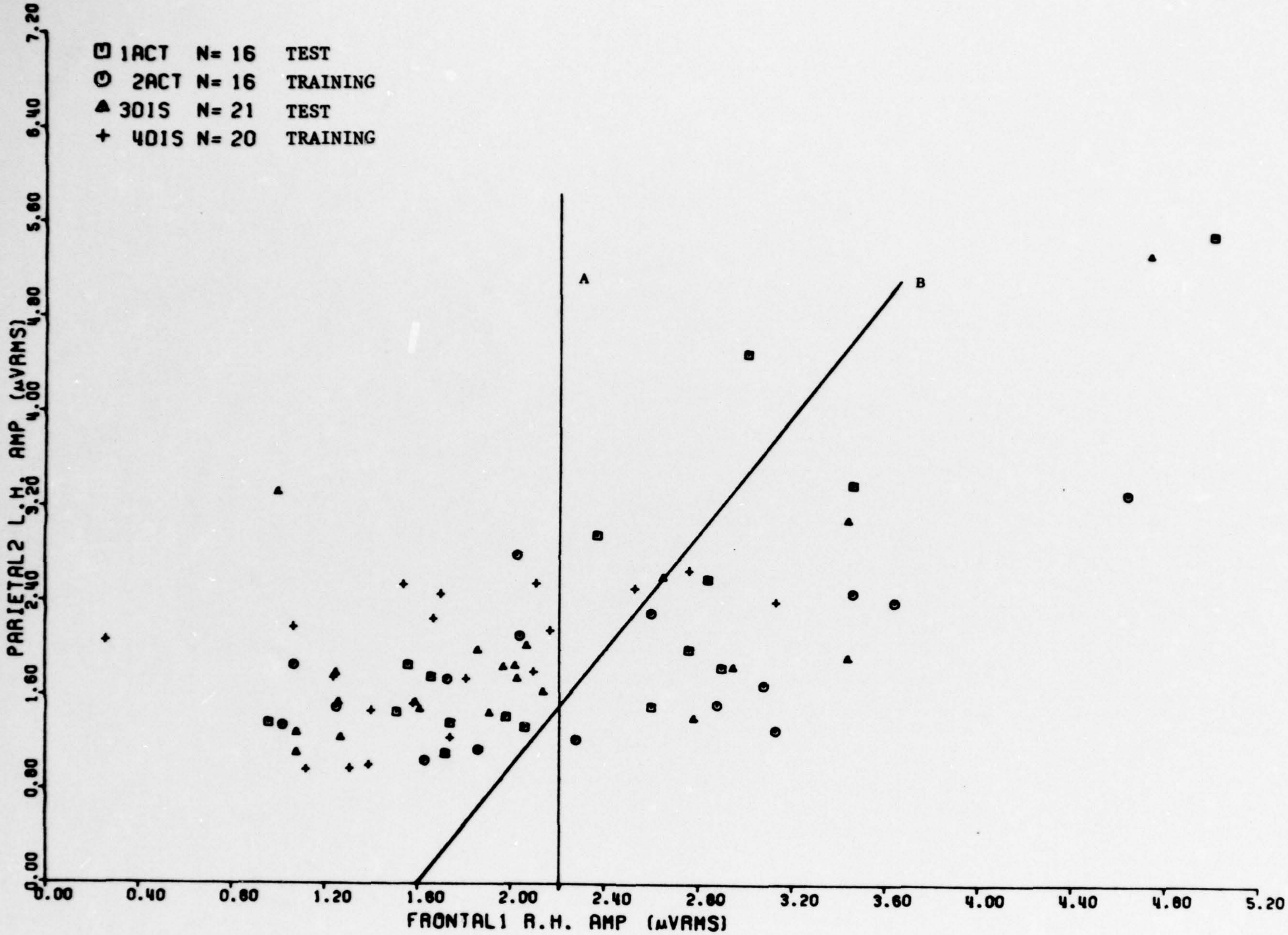

Figure 3. Bivariate distribution of ACT and DIS recruits on frontal and parietal EP variates.

DISCUSSION

Screening

The data show significant differences in VEP variates derived from recruits who were discharged from the Navy as recruit training failures and those of approximately equal aptitude who survived such training. This finding is consistent with the basic premise of the research: that psychobiological measures may prove valuable in the prediction of later behavior. On the other hand, the findings must be followed up and confirmed in additional samples, as well as among the members of the Active Duty segment of the present sample, before they can be considered firmly established. Such follow-up studies are in progress, and will be presented in later reports in this series.

An important qualification that must be borne in mind in assessing the significance of this study relates to the fact that, in order to study a high-risk sample, the subjects were drawn from the ART population of men with marginal reading ability. It is possible that the findings can be generalized only to such a group, rather than to the larger population that includes men with average and above reading skills. (Even if the findings pertain only to the poor readers, they would be of value, since considerable time and effort are invested in remedial reading training. A screening method for precluding enlistment of non-remediable poor readers would be valuable in its own right.)

Remediation

Much has been written about the need for individualized training. It is possible that psychobiological procedures may be used diagnostically to assign trainees to the methods of instruction most appropriate to their individual learning capabilities. In the present study, for example, the recruits discharged as remedial reading failures might have failed primarily because the remedial methods used were not compatible with their abilities. Perhaps a different instructional approach might be appropriate to recruits showing the VEP pattern found in this research to characterize remedial reading failures. An example of the successful application of a "neuropsychological technique for training dyslexics" has recently been described by van den Honert (1977). As van den Honert points out, there is a growing recognition of the need for such programs: "There is simply no coordination--in fact, not even any communication--between scientific researchers in the fields of neurology and teachers who need information about the most efficient ways of teaching." In the long term, the basing of training upon sound psychobiological methods may be expected to bring about significant reductions in the cost of Naval training--technical as well as remedial training.

Readers who have not followed VEP research literature during the past few years may be surprised at this report of a significant relationship between an individual's cortical electrical activity and his behavior. There is, in fact, a considerable body of related research, although much of it has been conducted with a medical orientation in experimental laboratories

not primarily concerned with predicting real life criteria, and using populations of school children (see Regan, 1972; Shagass, 1972; & Callaway, 1975, for book-length reviews of the EP literature). Illustrative of these studies are Eason, Groves, White, and Oden's (1967) report of the relationship between visual EP measures and handedness; Galin and Ellis's (1975) finding of EP attenuation over the left and right hemispheres respectively upon performance of verbal or spatial tasks (see also Buchsbaum & Fedio, 1969; Morrell & Salamy, 1971); and Callaway and Stone's (1969) report of a relationship between EP variance and visual motor integration.

The finding of a weak relationship between EP latency and premature discharge from the service is interesting in the light of the controversy that has developed since Chalke and Ertl (1965) reported a correlation between mental ability and EP latency. Some studies have supported the earlier finding (Ertl & Schafer, 1969; Shucard & Horn, 1972) while others have failed to find the relationships (Dustman & Beck, 1972).

The possibility that the findings of this study may, in fact, reflect differences between the ACT and DIS groups in the remediability of their reading deficiencies is suggested by the findings of Conners (1971) and Preston et al. (1974). Their research found decreased amplitude over the left parietal region of poor readers, as compared to controls. The fact that Shields (1973), on the other hand, found that children with reading difficulties exhibit a longer latency than control group children is somewhat inconsistent with the interpretation that reading ability is the primary difference between the ACT and DIS groups.

CONCLUSIONS AND RECOMMENDATIONS

The present research demonstrated that recruits prematurely discharged from training tended to show visual evoked potential characteristics, derived by computer-averaging techniques, that distinguished them from men of approximately equal aptitude who successfully completed recruit training.

Since the subjects were taken from Academic Remedial Training, the findings may be applicable only to recruits with reading-related problems. Further studies designed to evaluate this possibility, to confirm the findings on additional samples, and to evaluate VEP methods as predictors of on-job performance, are in progress.

The present findings are encouraging. They support the continuance of ongoing efforts to develop psychobiological methods of addressing the problem of recruit attrition by improving the processes of screening and remediation.

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